Operations Research

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

In This Issue

To cite this article:
(1991) In This Issue. Operations Research 39(6):866-868. https://doi.org/10.1287/opre.39.6.866

IN THIS ISSUE

Habitual Domains

A person's habitual domain is the set of ways of thinking, judging, and responding, as well as the knowledge and experience on which they are based. Over the last decade, Po L. Yu has been exploring this concept and building a theoretical structure on it aimed at accounting for many forms of behavior and decision making of interest to operations research workers. At the 1988 ORSA/TIMS meeting in Denver he gave a tutorial lecture on this work. In the *OR Forum* paper in this issue he offers an introductory view of the concept of habitual domains. He describes how they affect behavior, discusses their formation, dynamics, stability, and application, and points out how to expand and enrich them. Finally, he relates this concept to the OR profession to suggest how its habitual domains may be expanded and enriched, both individually and collectively.

Weapons and Force Effectiveness

The Gulf War, the military drawdown, arms control negotiations, and tight federal budgets have accelerated national decision makers' demands for useful estimates of the nation's conventional and combined nuclear and conventional forces capabilities. However, the analytical effort required for determining the effectiveness of an air-delivered conventional weapon against a single target makes large-scale conventional force analysis extremely difficult. Equally difficult is the allocation problem of weapons to targets for combined conventional and nuclear forces. In "A New Methodology for Military Force Structure Analysis," Mark Gallagher and Elizabeth Kelly make problems tractable by mapping the real-world target bases to a small but realistic set of representative targets and allocating weapons according to the targeting requirements. This methodology can assist in force structure decisions resulting from arms control treaties or reduced military budgets. In addition, future weapon system requirements can be determined by their aggregate impact on an entire campaign, rather than just by their capability against a small set of targets.

Characterizing Manufacturing Systems

In the past two decades the OR community has published hundreds of papers describing applications of OR methodology to manufacturing. These papers have considered manufacturing systems ranging from a simple, single machine to a complex semiconductor fabrication factory and have described a broad spectrum of applications, including simulation, optimization, queueing, heuristics, and computational complexity. Certainly great progress has been made, but it remains difficult to assess the overall state of OR solutions for manufacturing. This difficulty, and the need for a unifying framework within which to position and evaluate research was discussed by W. Maxwell et al. at the May 1985 ORSA/TIMS conference. In "A Taxonomy of Discrete Manufacturing Systems," B. Dietrich provides a preliminary classification scheme for discrete manufacturing systems. The taxonomy provides researchers new to the area with insight into the great diversity of manufacturing problems, and may incite experienced researchers to consider broader applicability of existing solutions, and more general frameworks for new solutions.

Emergency Vehicle Busy Probabilities

Methods to estimate the performance of emergency systems have a history of successful application since the work done by Savas and the New York RAND group in the late 1960s and 1970s. One often used method consists of a model that is a system of nonlinear equations and an accompanying solution method. The model has undergone validation on actual systems, however, the convergence properties of the method, and the uniqueness of the model's solution have remained largely unexplored. In "Methods for Solving Nonlinear Equations Used in Evaluating Emergency Vehicle Busy Probabilities," Jeff Goldberg and Ferenc Szidarovszky analyze the convergence properties of the solution method. They show that the method always converges to a solution and the uniqueness of the solution can be verified numerically. These results have been incorporated into a graphics based computer package that has been used to determine base locations for emergency vehicles for the Tucson Fire Department.

Designing Frequency Domain Screening Experiments

When running frequency domain factor screening simulation experiments to identify important terms in a polynomial metamodel of the simulation

response, the choice of driving frequencies for each input is critical to the effectiveness of the methodology. In particular, confounding of term indicator frequencies, unnecessarily long simulation run lengths, and system filtering effects are problems to be considered. In "Driving Frequency Selection for Frequency Domain Simulation Experiments," Sheldon Jacobson, Arnold Buss and Lee Schruben introduce a simple heuristic that efficiently solves for driving frequencies. Using the heuristic, optimal and near-optimal driving frequencies are computed and tabulated for various numbers of inputs for quadratic and cubic polynomial metamodels.

Bundling in Telecommunications

The emergence of high rate fiber optic transmission systems and increased demand for higher rate telecommunications services, such as data and video, in local and long distance digital networks has resulted in the rapid expansion of digital multiplexing rates. Effective use of multiplex equipment through multiplex demand bundling results in significant reduction in the cost of equipment and transmission facilities deployed in the network. However, in telecommunications network planning, exact solution of the multiplex bundling problem is intractable and effective methods for its solution have not been widespread. In "Algorithms for Multiplex Bundling in a Telecommunications Network," Robert Doverspike formulates the multiplex bundling problem and presents heuristic methods for its solution. In addition, these methods are integrated into the strategic network planning system used by the Bell Operating Companies to demonstrate their value and implementability. The multiplex bundling algorithms significantly reduce network costs.

Shake-and-Bake

The classic Monte Carlo method for generating a uniform random sample of points within a geometric region is to enclose the region within a rectangle, and then generate a sample of points within the rectangle, rejecting those that fall outside the region. There is, however, no equivalent rejection method for generating a random sample of points on the boundary of a region. In "The Shake-and-Bake Algorithm for Generating Uniform Points on the Boundary of Bounded Polyhedra," Boender et al. propose an acceptance procedure that generates a sequence of points that "bounce" over the boundary of a polytope. The authors show that large samples of such points are asymptotically uniformly distributed over the boundary of the polytope. Potential applications are diverse, ranging from area estimation to constrained optimization.

The Complexity of Linear Programming

The question of how difficult it is to find an optimal solution to linear programming (LP) problems is of practical and theoretical interest. There are many instances that are relatively "easy" to solve in practice, as evidenced by a preponderance of applications for which LP has successfully provided for reasonable decision making. However, on a theoretical basis, the set of "easy" problems (i.e., those which are solvable in strongly polynomial time) is, for the most part, limited to instances in which the constraint matrix has relatively small entries. In "A Strongly Polynomial Algorithm for a Special Class of Linear Problems," Ilan Adler and Steven Cosares identify a class of LPs which are solvable in strongly polynomial time, even if the constraint matrix entries are arbitrarily large in size. The class includes the generalized transshipment problem and its dual.

Sensitivity Analysis in Location Problems

Previous work in location analysis commonly assumes that precise values are available for the underlying parameters of a model. In practice, it may be difficult to obtain accurate estimates. In particular, lack of relevant data (e.g., about costs) may necessitate making a rough approximation. Also, the values of parameters may be based on a forecast of questionable accuracy, and simplifying assumptions inherent in modeling a real problem can yield imprecise estimates. This motivates the need to study the sensitivity of a model's solution to variations in its parameters. In "Sensitivity Analysis in Minisum Facility Location Problems," Martine Labbé, J. F. Thisse and Richard Wendell propose a framework to perform a sensitivity analysis for minisum facility location problems. They consider the problem of locating a new facility to minimize a weighted sum of distances from given demand points. Using the tolerance approach, they characterize and compute a tradeoff curve between the size of perturbations in the weights and the degree of optimality of a solution to a minisum problem.

Manufacturing Systems With Interactions

Most manufacturing systems involve several machines and multiple products that respond to discrete events, such as machine failures and repairs. The control problems for these systems are large in scale and complex in nature. One way to deal with these problems is to decompose them into manageable subproblems so that their solution leads to a good

approximate solution of the largely unsolvable, original problem. In "A State Aggregation Approach to Manufacturing Systems Having Machine States With Weak and Strong Interactions," J. Jiang and S. P. Sethi suggest a hierarchical approach to control a class of manufacturing systems with machine state fluctuations modeled by a Markov process with weak and strong interactions. They show that aggregating strongly interacting states results in a problem of reduced size, whose solution can be modified to obtain an asymptotically optimal feedback solution to the original problem.

Scheduling Deteriorating Jobs

Detailed scheduling of production or service orders is crucial to controlling production operations or improving the quality of service. In "V-Shaped Policies for Scheduling Deteriorating Jobs," Gur Mosheiov addresses a deficiency in classical scheduling models, namely the assumption that the processing times of jobs are constant and independent of their starting times. In practice, one often encounters settings in which jobs deteriorate, i.e., their processing times increase over time. In production settings this may occur when machines lose efficiency as time progresses. Other applications include maintenance, repair, or cleaning operations. The paper discusses efficient scheduling methods for linearly deteriorating jobs which minimize total waiting or flow time, identifies several useful properties of an optimal schedule, and introduces simple solution methods.

Routing Printed Circuit Cards

One strategy for the flexible assembly of printed circuit cards is to determine an assignment of components to placement machines, then route assemblies to the machines required to complete them. While the component placement sequence is almost unconstrained, there are some factors that induce precedence. Christopher Lofgren, Leon McGinnis and Craig Tovey study the routing decision problem for the case of placement precedent constraints. In "Routing Printed Circuit Cards Through an Assembly Cell" they show that the routing decision problem is theoretically hard, and sensible heuristics can give arbitrarily bad performance. They conclude that one should attempt to eliminate the part routing problem through product design and process improvement, rather than attempt to find optimal or near-optimal solution algorithms.

Parallel Branch and Bound

Branch and bound is a well established enumerative technique for solving hard combinatorial problems. Unfortunately, the computing time for most realistic problems tends to be enormous. With the advent of parallel computers many people have developed parallel versions of existing branch-and-bound algorithms. The reported results are promising. One can, however, provide instances for many parallel algorithms for which the proposed implementation does not work. In "A Queueing Network Model for Analyzing a Class of Branch-and-Bound Algorithms on a Master-Slave Architecture," O. J. Boxma and G. A. P. Kindervater give a model for a broad class of parallel branch-and-bound algorithms. The model can be analyzed with techniques from queueing theory, thereby explaining the observed behavior of the considered algorithms and predicting the effectiveness of the algorithms in certain cases.

The Accuracy of State-Space Truncation

Markov modeling is a generally accepted tool to evaluate reliability, computer, manufacturing and telecommunication systems. The state space required in such applications is often astronomic, so that computations are extremely expensive, if not impossible. In "Truncation of Markov Chains With Applications to Queueing," Nico van Dijk provides conditions by which one can conclude analytic bounds on the inaccuracy of approximations by state-space truncation.